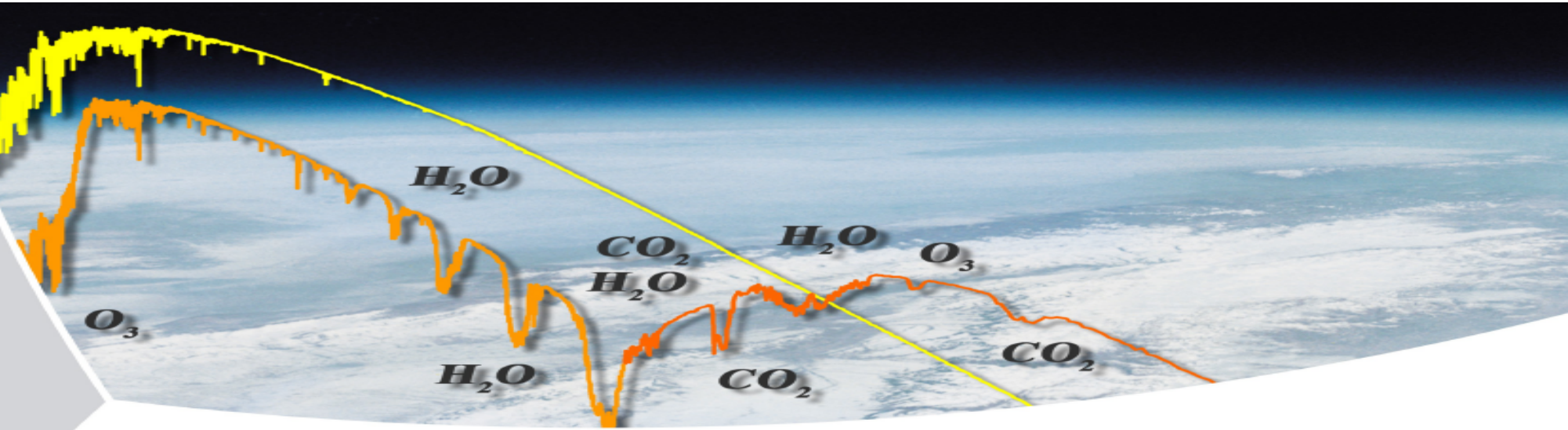

Validation of Vertical Profiles & Column Densities Retrieved from Nadir IR Sounders

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June 2015

Impact of Spectroscopy on SCIAMACHY Nadir IR

Master Thesis Denise Schmidt

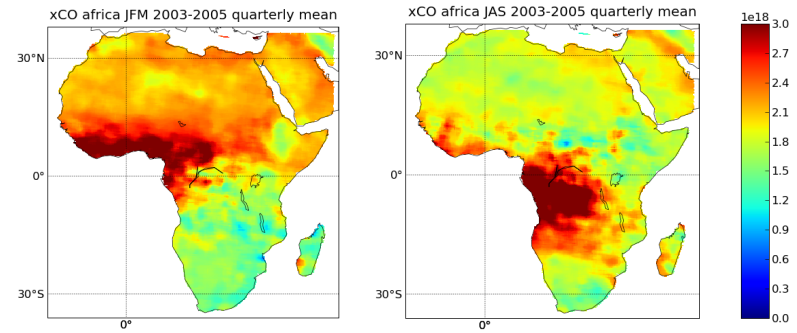
- BIRRA Beer InfraRed Retrieval Algorithm
  $I(\nu) = r\, I_{sun}\, e^{-\sum_m \alpha_m \tau_m} \otimes S(\gamma, \delta)$
  fit density factors to intensity

- Line-by-line optical depth τ:
  HITRAN vs. GEISA **?¿?**

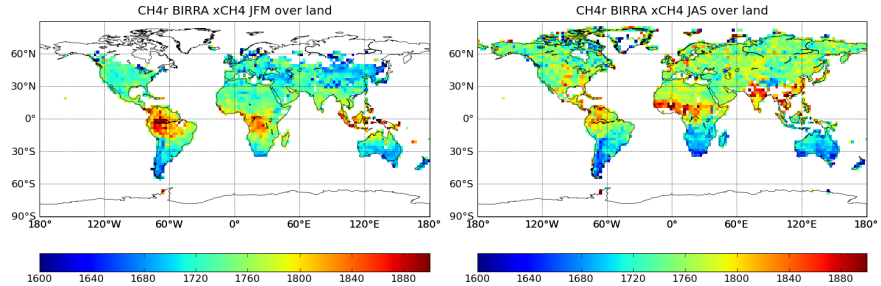
$\Rightarrow$ tiny change of residuals, scale factors α and related errors $\delta\alpha$

- Work in progress:
  — SCIA channel 6: CH_4
  — GOSAT and/or S5P

CO: one μWindow in channel 8



CH_4: two μWindows channel 6



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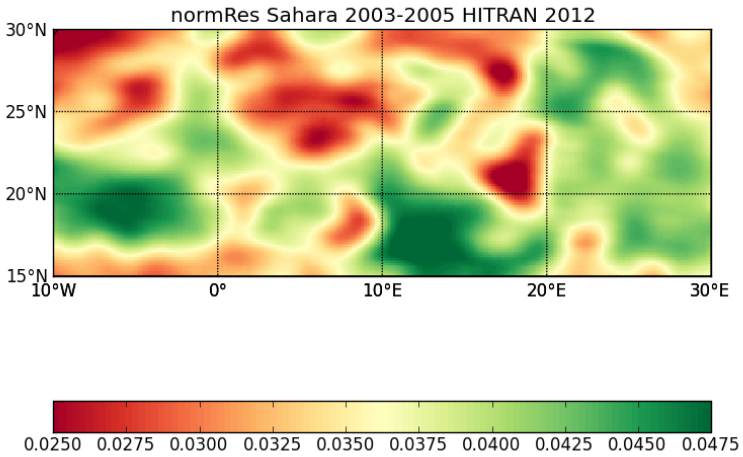
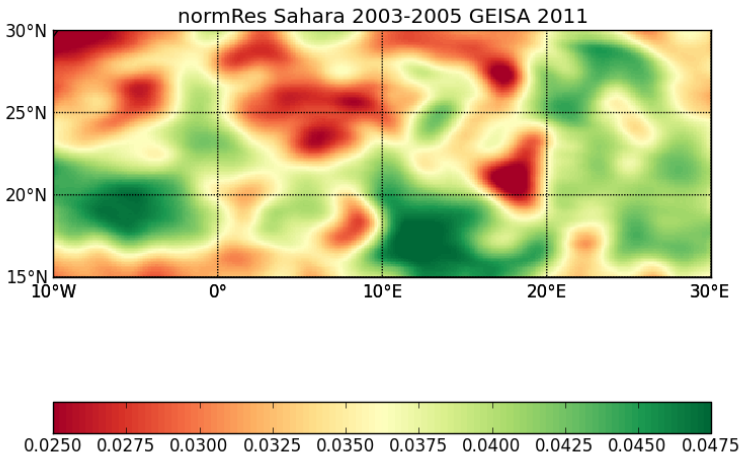
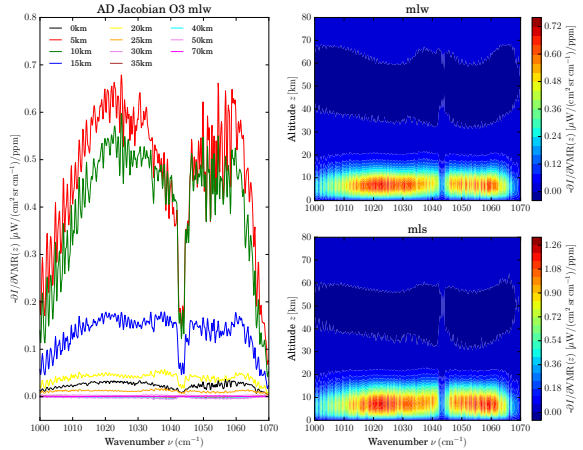




Algorithmic Differentiation vs. Finite Difference Jacobians

- Analytic derivatives: tedious, error prone!
  Finite differences: time and accuracy?
- Even large codes: a sequence of simple math operations
- Differentiation: few simple recipes
- Differentiation rules can be performed automatically by a “precompiler”:
- ⋆ Automatic differentation generates exact derivatives efficiently
- ♡ GARLIC with Tapenade $\Longrightarrow$ Execution time only factor 2 for full temperature Jacobian (nadir)

(JQSRT accepted)



Relative error of finite diff. O_3 *Jacobians:*